INPUT

FIELD SERVICE PROGRAM

FIELD SERVICE BRIEF

INVENTORY MANAGEMENT AND CONTROL

AUGUST 1980

FIELD SERVICE PROGRAM

OBJECTIVE: To provide senior field service managers with basic information and data to support their planning and operational decisions.

DESCRIPTION: Clients of this program receive the following services each year:

- Field Service Briefs - Six reports which analyze important new technical and management issues within the field service areas. Reports focus on specific issues that require timely attention by senior management.
- Major Planning Reports - Three reports that present an in-depth analysis of major technical or management issues. They make recommendations that will assist in the formulation of major policy alternatives in the planning of field services.
- Annual Report - This report summarizes the year's major activities in the field services industry to determine important trends and their effects on future field service planning. Forecasts are provided of likely changes in technical and management areas which, when they occur, may affect the future requirements of users of these services.
- Annual Presentation - INPUT staff makes an annual in-house presentation to field service executives to summarize the results of the previous year's research and to formulate, jointly, the strategic guidelines for the research program for the current year. These presentations will occur in the first half of each year.
- Consulting Support - Individual consultation with INPUT research staff on an as-needed basis through telephone inquiries and visits.

RESEARCH METHOD: INPUT carries out extensive research in computers, communications and associated fields:

- Research topics are selected by INPUT based on discussions with client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are based on the judgement of INPUT's staff.
- Professional staff members supporting this program have 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

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ABSTRACT

This report outlines the differences between inventory control in a field service environment compared to a manufacturing environment. The special considerations are described which relate to effective inventory management in the changing task of effectively managing the assets represented by inventory in a field service organization.

F-FS6
August 1980

INVENTORY MANAGEMENT AND CONTROL

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I INTRODUCTION

I INTRODUCTION

A. IMPORTANCE OF INVENTORY MANAGEMENT AND CONTROL

- Inventory management and control is an increasingly important element in field engineering strategy.

  - The costs of money, space, insurance, spoilage, obsolescence and the like are causing the annual cost of merely carrying inventory to approach 40% of the cost of the inventory itself.

  - As labor costs increase, inventory outages can contribute to labor cost through requiring multiple visits.

  - Because of the trend to distributed data processing, the number of stocking points is increasing, thereby further complicating the subject.

- This Field Service Brief is designed to provide a first look at the subject and to open a dialogue with clients. In 1981, assuming adequate client interest, INPUT plans to do more comprehensive and in-depth work in the area of inventory management and control. This brief provides a review of the major elements involved.

- The goal of inventory management is to satisfy customer and internal needs for parts and supplies while contributing to profit.

- To maximize profits, service representatives must be effective and parts sold must yield the greatest income. Satisfied customers tend to use their equipment more often and order new supplies, thereby contributing further to total revenues.

- Inadequate inventories often result in unhappy customers whom field engineers must placate with "band-aid" repairs, returning later with the needed part. Meanwhile, management time is spent chasing parts, potential revenues are lost, and the productivity of field engineers and others is diminished.

• The same profit criteria applied to any product or project also apply to inventory control. A 30% return on investment (ROI) on spares inventories is a good, typical objective.

  - A 30% ROI means that $1 million in inventory held for a year should produce an annual profit of at least $0.3 million.

  - Profit margins on parts sold (or included in price calculations for lease and contract services) range from 10% to 700%, with typical markups of about 100%. In the cast of at least one major manufacturer, the markup is ten times the transfer price from manufacturing.

• The basic resources of field service are labor and parts. Since the cost of labor is increasing faster than the cost of parts, management should emphasize service concepts that reduce expensive labor and increase parts use.

  - A recent survey of over 60 service representatives in a well-run "Fortune 500" organization showed that they spent 4.0% of their time obtaining parts.

    . Forty percent of that time, or 1.6% of paid time, was a necessary, productive, parts-related effort.

- Sixty percent of that time, or 2.4% of paid time, could have been avoided. Typical activites in this category included returning parts to stock, exchanging defects, cannibalizing, checking on backorders, and travelling to get parts. The value of that time averaged about $1.20 per service representative per hour.

- Remote diagnostic self-test and built-in-test (BIT) capabilities improve diagnostic speed and accuracy.

  - Presently, an estimated 35-45% of all electronic modules returned for repair are actually in good working order. A significant reduction in this area through remote diagnostics will in turn reduce float inventories and demand for repairs.

  - Users will want more parts on hand to reduce downtime; placement of spare parts at users' sites is a matter of increasing importance.

- Inventory considerations are a major part of repair versus discard decisions.

  - Integrated subassemblies cost less to manufacture but generally cannot be repaired either in the field or in the shop. They are simply discarded. This increases inventory dollars.

  - Packing, shipping, handling, testing and minimum repair will cost at least $25 for a given part. Any part of lower value should be discarded unless replacements cannot be obtained.

- Inflation is forcing some users to reduce new equipment purchases through better maintenance of existing equipment.

  - This requires service organizations to keep a higher level of support inventory. At the same time, costs of both the parts and the carrying expenses are increasing.

- As a side effect, some equipment manufacturers' parts backorders are being reduced. Supplies made available through reduced production levels can fill field service needs instead.

- In many cases, inventory on hand is increasing in value due to higher replacement costs and long resupply times.

- Accounting procedures should switch from the traditional first-in-first-out (FIFO) method to a last-in-first-out (LIFO) method in order to minimize taxes; in effect, the most recently purchased (higher priced) part is charged to expense, rather than the part purchased earlier (at a lower price).

B. TECHNOLOGY CHANGES

- The need to constantly introduce new equipment to capitalize on technological advances impacts the inventory process.

- One mainframe vendor depreciates spares inventory over a four-year period.

  - This adds greatly to annual cost when a new mainframe family is introduced and the spares inventory is created.

  - As the mainframe family approaches the end of its life after four years, much of the remaining spares inventory has been fully depreciated.

  - This allows the use of "zero cost" spares, and greatly increases the reported profitability of maintenance at that point in the product life cycle.

- More sophisticated technology, increased packing density and integrated assemblies all result in more expensive parts. This increases the cost of initial spares float.

- To the extent that technology improves the reliability of equipment, the amount of required spares inventory may decline.

  - Technology forecasts must be part of inventory planning.

  - The importance of technology is increasing not only with regard to the cost of inventory, but with regard to the location of inventory.

C. RECOMMENDATIONS

- Service parts inventory management must be recognized as critical and requires the attention of field service top management.

  - Cost of carrying inventory has a direct impact on profits.

  - Inventory stockouts have a direct impact on morale and customer satisfaction.

- Inventory control should be part of an overall strategy.

  - The quantity of assets invested in inventory can be traded off against assets committed to personnel staffing and training; often inventory costs are increasing more slowly than labor costs.

  - New product design should include inventory considerations. For example, the level of on-site repair must be considered, versus swapping of modules.

- The timing of new products must consider the impact on inventories required to support existing products.

- The form of maintenance offered on a product must be taken into account when structuring the inventory strategy. For example, the IBM 3101 terminal with its offering of depot maintenance eliminates the stocking of spares at other than depot locations. In effect, the customer takes on some of the inventory responsibility by ordering "spare" terminals.

- Management must consider the impact of new techniques on inventory issues. For example, a remote diagnostics system can impact an inventory control system.

  - Remote diagnostics can often identify the faulty part, reducing unnecessary repairs.

  - Remote diagnostics can feed information about failure rates, etc., into the inventory control system, thereby helping in designing restocking rates.

- Management must recognize that good inventory planning and control requires qualified people and involved managers who can set goals, establish alternatives, gather facts, perform analyses and make decisions. Management must be involved in the process.

II SETTING PERFORMANCE OBJECTIVES

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A. GOAL-SETTING CONSIDERATIONS

- Objectives for inventory management and control should be set by service management. They must be supported by logistics, administration, finance/control and marketing; but those organizations should be ancillary. Since service management is responsible for inventory, service management must be in control.

  - Typical desired performance goals for service parts are displayed in Exhibit II-1.

  - Goals are, of course, a necessary foundation for inventory management.

- There are ten major differences between the way parts have normally been handled for manufacturing/production operations, and the way they should be handled for the service business:

  - Product life phases.

  - Future demand variability.

EXHIBIT II-1

TYPICAL GOALS FOR INVENTORY MANAGEMENT AND CONTROL

GUIDELINES	GOAL
• At least 95% (19 out of 20) of all orders should be completely filled. • Field service representatives should have access to enough parts to fill 80% of their needs within 15 minutes. • At least 95% of customers' essential needs should be met within four hours. • Any customer calling a district office or order entry should receive assistance necessary to order any replaceable part, with a 95% success rate on initial shipment and 100% by second selection.	COMPLETENESS OF INVENTORY
• Orders received by customers and representatives should be at least 95% accurate. • Packing slips should accurately indicate all the items shipped. • No more than 1% of all parts received should be defective due to QC or damage.	ACCURACY OF INTERNAL CONTROLS
• All orders received by noon for emergency parts should be shipped the same day by the fastest means. • All orders should be entered the same day they are received.	TIMELINESS OF RESPONSE TO ORDERS

EXHIBIT II-1 (CONT.)
TYPICAL GOALS FOR INVENTORY
MANAGEMENT AND CONTROL

GUIDELINES	GOAL
• Ninety-five percent of in-stock items should be shipped by noon of the next working day. • One hundred percent of in-stock items should be shipped by noon of the second working day. • Out-of-stock items: – Ninety percent should be scheduled within two working days. – One hundred percent should be scheduled within four working days. – Ninety percent should be shipped within ten working days. – Ninety-five percent should be shipped within twenty working days. – All back ordered parts received by noon should be shipped the same day. • All new customers should be entered on the file and processed for shipment within one working day.	TIMELINESS OF RESPONSE TO ORDERS (CONTINUED)
• Average inventory investment at cost should not exceed fifteen percent of sales. • Average turns of inventory valued at cost should be at least 3.5 times per year.	FINANCIAL CONTROL
• Parts-related problems that cause a customer to contact management should be fewer than 0.1% of orders.	CONTROL OF CUSTOMER COMPLAINTS

- Causes of replacement.

- Multiple locations.

- People influence.

- Risk.

- Essentiality.

- Flexibility.

- Gain or loss avoidance.

- Systems approach.

I. PRODUCT LIFE PHASES

- There are three distinct phases of life for service parts: (1) new product introduction, (2) ongoing, and (3) termination. Different inventory control practices are often required for each of these phases.

  - Inventory for new products involves brand new equipment, very little history, some correlation with prior products, reliability predictions, some laboratory tests and, most importantly, people's best engineering experience and educated judgement.

    - Planning inventory for new products requires input from engineering, quality assurance, production, marketing and experienced field personnel. Initial stock-keeping unit (SKU) identification should be based on a part's expected failure rate. Reliability engineering can assist with failure modes, effects and

criticality analysis. Quantities are based on the location of stocked spares, lead times for resupply, essentiality and cost. Experience with comparable, existing products is the best guide.

  . The need for adequate replacement parts as well as trained personnel, tools and information should force consolidation of early installations.

- Once experience is gained with products (generally at about the six-month point), inventory of replacement parts may be assumed by the ongoing system.

  . Engineering changes, modifications, new versions of equipment and even new markets often cause products to revert to initial provisioning techniques.

- The termination phase requires the acquisition of enough parts to support service needs as long as the products remain in use.

  . End-of-life planning for parts must take place when a product will no longer be manufactured. Management must decide how long the product will be supported after production is terminated. Spares analysts must then forecast part demand during that period.

  . Additional purchases after production has stopped will be very expensive, even if drawings and tools are retained, so the end-of-life spares should be made during the last production run.

  . Sales personnel can assist both themselves and inventory control by replacing obsolete products in the field with the new products in the vendor's line.

2. FUTURE DEMAND VARIABILITY

- Future demand for service parts will vary much more than current demand. Experienced inventory planners must work closely with engineering and marketing to forecast changes.

  - Engineering can help predict reliability changes, pending modifications that can eliminate or revise a part, and vendor problems. Inventory planning should receive all engineering change orders (ECOs).

  - Marketing can project the product's installed population over time, territories serviced, and special environments or uses that could alter demand.

  - A good inventory analyst can plan and control 10,000 to 12,000 line items.

3. CAUSES OF REPLACEMENT

- There are many causes of replacement in addition to failures, including incorrect manuals, wrong diagnostics, inaccurate testing, ease of replacement, poor training and "shotgun" replacement due to lack of discipline. Design improvements are preferred to attempts to solve a replacement problem by training.

  - Engineering changes require several months to design and implement.

  - Training may provide only short-term improvement. The high turnover rate of personnel means, however, that new technicians must be trained about every two years. Also, unless a task is frequently reinforced, proficiency will be lost.

  - The useful life of most spare parts is at least five years. Therefore the investment in design improvements can be justified in better parts and

support design to reduce failures and eliminate causes of unnecessary replacement.

4. MULTIPLE LOCATIONS

- Parts may be stored in several locations, including field engineers' car trunks, district or branch offices, regional distribution centers and a national distribution center. This is a much more complex problem than having parts in one or two manufacturing locations.

  - Inventories should be consolidated as much as possible, consistent with providing a timely supply.

  - The tradeoff is between parts delivery time and consolidation. Elapsed time will be shortest if parts are within the field engineer's immediate reach. Elapsed time will increase with a central inventory, but central inventory offers reduced total quantities on hand and improved controls.

  - This determination can be made individually for each part, with general guidelines for groups of parts.

    - Highly essential parts, which turn over at least four times a year and cost less than $90, should be carried by field engineers.

    - Less essential parts, with primarily cosmetic or convenience value, should be centralized and ordered for installation at the next service call.

    - Parts in between these bounds should be evaluated on the basis of potential profit or loss to the inventory control function.

  - Knowing where parts are is critical. A recent survey showed that fewer than 5% of the electronic equipment service organizations contacted

knew the present inventory in their field engineers' car trunks. One west coast company last year cancelled spares orders to "shake out" the parts that had accumulated in the possession of the field engineers.

5. PEOPLE INFLUENCE

- Service parts are still a "people" business, and people are often the critical element in the success or failure of an inventory control system.

  - Management direction has a very strong influence on field engineers' actions. Managers often fail to provide adequate training for field engineers to judge when to repair versus when to replace a part.

    - Field engineers have a tendency to attempt to repair whenever they feel capable. This could be a false economy. The field engineers must be trained and guided to consider the options in order to make a good business decision.

    - One observed instance cost a company $150 in labor (in this case, for a $3 switch) because a manager told a field engineer that his parts were costing too much money.

  - The people involved in parts replacement go far beyond the field service organization. The parts demand-supply curve has many elements, including identification of the correct part number, order communication, availability, customer credit assurance, and picking, packing, and shipping of the proper quantities so that they are received ready for installation. Accounting, credit, sales, production and physical distribution centers are usually all involved with providing parts to field engineers and customers.

6. RISK

- Carrying enough parts to fulfill 100% of all needs is too expensive. Therefore some risk of being "out of stock" must be taken.

  - Management often does not realize that even a success rate as high as 90% still leaves 10% failures.

  - Since demand will not be equal for all line items, a few stock-keeping units (SKUs) will fill most of it.

    . A/B/C Analysis, also known as the "Principle of the Critical Few and Insignificant Many," "Pareto's Law," and the "80/20 Rule," helps direct attention to the most important items.

    . Pareto's Law suggests that, regardless of inventory ordering criteria, the distribution of parts, on a percent basis, will remain the same.

    . An 80% service level can usually be met with less than 20% of all field-replaceable parts. A 90% level has been observed with only 10% of the possible replacement parts in stock, correctly chosen in proper quantities.

7. ESSENTIALITY

- Essentiality is a method of rating the importance of a part so attention can be directed to priority items.

  - A 4/3/2/1 rating system is typical. A "4" rating is a sign that the concern is of safety or legality, or the part is likely to cause complete shutdown if it fails and needs to be replaced. A "3" rating means that lack of the part causes equipment to be non-operational; a "2" means slightly degraded performance; while a 1-rated part is a minor cosmetic

item. The CPU board would probably be rated 4, a disk drive 3, an interlock 2, and a panel light cover 1.

- A part's rating of essentiality allows rapid calculation of the total system's essentiality.

- The rating number should be assigned to each part by field engineering with the concurrence of inventory planning.

- Attention should be paid first to all 4-rated parts, then 3s, 2s, and finally 1s. If the inventory budget is restricted, it should be invested first in all the needed 4-rated items, working down in priority on lower-rated items until the money supply is exhausted. This could mean that no 1 or 2 items are stocked; but the effect on customer satisfaction should be minimal.

8. FLEXIBILITY

- Flexibility is important to service parts inventory management since more than one source can often be used to solve a parts storage problem. This involves an ability to determine where the needed part might be among several different locations. In addition to getting a part from inventory, the use of the next higher assembly, borrowing from other products the part is used on, or even cannibalization can provide alternatives.

- Inventory and field service personnel often go to extreme efforts to get parts necessary to satisfy customers.

  - Managers must be alert and not allow special efforts to become normal, due to the impact of such efforts on costs.

  - Emergency orders exceeding 10% of total orders is a sign of trouble.

9. GAIN OR LOSS AVOIDANCE

- Though little used at present, gain or loss avoidance is an effective, quantitative means of determining parts and quantities to be stocked.

  - A part should be stocked if:

    Unit Cost x (1 + Holding % + ROA) x Quantity $(\Sigma_1^Q P$ of Demand) x Value Gained or Loss Prevented.

    - For example, consider a communications printed circuit board (PCB) that costs \$200. If the holding cost percentage is 30%, keeping the board in inventory will cost \$60 per year. If profit goals are 30%, then the ROA (return on assets) desired is another \$60 per year. Quantity is evaluated for 1, then 2, etc., until the cost of having the part exceeds its expected value. Thus the cost of stocking one PCB is \$120 per year (\$60 plus \$60), two would cost \$240, etc.

    - If parts are sold at a profit, the gain is the margin made on each sale. If equipment is leased or supported on contract, warranty or fixed-price, then loss avoidance for special expediting, additional field engineering efforts and lost revenues can be quantified.

    - For example, the PCB probability of demand is determined from inventory records or forecast by reliability and maintainability (R&M) engineering. Assume the probability of need is 0.4, and, if the PCB is not on hand, the service representative will have to spend \$600 worth of time, travel and expediting to get one. The value of having the PCB is then (0.4 x \$600) = \$240. Since the value is greater than the cost, that PCB would be stocked. To determine if a second board should be carried, have R&M Engineering calculate the incremental probability of need for a

PCB while the resupply of the first board is taking place. That probability of need will be low, perhaps 0.01, so the cost of carrying a second PCB exceeds the expected value and the decision is easily made to carry only one.

- A similar calculation can be done for each possible stock level.

- While the profit concept is not directly applicable to leased equipment or others where the parts must be provided without additional direct compensation, most organizations do hold a reserve for lease accounts that can be treated in similar fashion.

- For each contract, contract pricing and expense analysis should evaluate the parts and their costs compared with the revenues in order to assure a reasonable profit. This capability should be included in the service management information system.

- Parts sold through dealers provide little information on usage if the dealers may also obtain parts from other sources. The same problem must be carefully watched if internal personnel obtain parts from multiple sources.

  - Close contact with field personnel in either a direct labor force or third party is necessary to track true parts use.

  - Managers should restrict field engineers to using only those parts furnished directly by their company or by other authorized, high-quality sources.

10. SYSTEMS APPROACH

- A systems approach to service inventory management is vital. The elements discussed above should be integrated over the entire product life cycle.

- The major reason for overstocking parts is a lack of confidence in adequate, timely resupply.

    - Minimum down-time results if the service representative has the part or can get it within, for example, one hour. If the part arrives after one hour, the service representative, in order to utilize time effectively, may go on to another job and probably will not return to replace the needed part until much later.

- Standardization pays large dividends. Not only are fewer parts required and costs lowered, but also the need for training, tools and manuals is reduced. Program management must ensure that tradeoffs between field service requirements and those of marketing and engineering are well defined and understood.

- Stock lists should be established based on population requirements and special conditions.

    - These parts are identified by field engineers, as discussed earlier, and quantities are established in cooperation with inventory planning.

    - Stocking points should be required to stock those parts within 10% of the recommended quantities if the territory and product load are constant. Adjustments may be provided for out-of-territory calls if additional parts could be required there. Field engineers often consider the use of stock lists extremely restrictive, but experience shows that the lists are a necessary tool for planning and control.

III FINANCIAL CONSIDERATIONS

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A. CARRYING AND HOLDING COSTS

- Carrying and holding costs include space, security, information, obsolescence, protection from damage, insurance and either the cost of money invested in inventory or the value of forgone investment in other alternatives.

  - The federal government and several corporations all estimate that the overhead required to add a single line item to inventory is $2,000.

  - Carrying cost will generally range from 20% for small, stable, low-value parts to 30% for electronic components that are more valuable and subject to obsolescence, theft and damage.

B. ORDERING COSTS

- The placement of every order, regardless of quantity, involves a minimum cost for processing the order. The lowest purchase order costs found in a recent survey were $15 each, while the single highest was $475, which included inspection for quality control. The number of orders should be minimized

consistent with the economic order quantity (EOQ) calculation, which balances carrying cost against order costs.

C. STOCK CLASSIFICATIONS

- Inventory classifications include working stock, pipeline, safety, loaned and investment/speculation.

  - Working stocks are those in the possession of field personnel ready for use as required.

  - Pipeline parts are in transit or in a basic inventory stock location.

    - Filling the "pipeline" requires an initial stock of parts above equipment needs.

    - Quick turnaround on factory repairs can significantly reduce inventory.

  - Safety stocks are extra quantities kept as insurance against increased demand or slow supply.

    - A centralized safety stock with good communications and transportation is more cost effective than safety stocks at multiple, remote locations.

    - Catastrophic safety stocks must be maintained so that a disaster does not demolish the ability to provide service.

  - Loaned stocks are those temporarily in use by a customer or another field engineer. They should be returned to the original owner if a priority need occurs or a replacement is received.

- Investment/speculation stocks are those held because their future value is expected to increase significantly. For example, changes in gold and silver prices have recently affected some component prices. However, inventory managers are advised to concentrate on the value of their inventories to customers, and to leave commodity dealing to specialists.

  . Vendors and major distributors sometimes offer to hold inventory in their own supply, either as shared resources or as dedicated materials.

  . In order to reduce lead times, it may be necessary to commit to buying basic raw materials at an early stage, with a postponed commitment to production.

D. CAPITAL VERSUS EXPENSE

- Parts in inventory should be capitalized until they are used; i.e., actually installed in equipment.

- Expensing parts when they are shipped from production to the service organization, or even to the field engineer, invites an Internal Revenue Service (IRS) audit, because the IRS will consider the part still in inventory.

E. FIFO, LIFO AND SPECIFIC GOODS

- First-In-First-Out (FIFO), Last-In-First-Out (LIFO), and specific goods are standard approaches to accounting and physical movement.

- LIFO is best in periods of inflation since the amount of taxes paid on paper profits will be lower than with FIFO, as discussed earlier.

- Physical movement should be FIFO to keep the inventory turning over and to avoid obsolescence, shelf life and storage exposure to possible damage. Accounting may be LIFO.

- Stock-Keeping Units (SKUs) that are serial-numbered should be individually controlled and valued as specific units. This gives better control than the quantity-count system used by many companies.

IV MANAGEMENT INFORMATION NEEDS AND CONTROL TECHNIQUES

IV MANAGEMENT INFORMATION NEEDS AND CONTROL TECHNIQUES

A. THE NEED FOR TIMELINESS

- An inventory management and control system must provide accurate information to the individual field engineer level. A part should always be in a known location.

- The availability of parts at any given time within every location of the organization should be known on at least a daily update basis.

  - This information can be maintained with manual or computer-based systems, and can be enhanced using certain advanced techiniques. These topics are discussed in the following sections.

B. PLANNING AND CONTROL TECHNIQUES

- A potential technique is Materials Requirements Planning (MRP) which is in widespread use in production environments. A recent American Production and Inventory Control Society (APICS) survey showed that 47% of the companies surveyed currently use MRP for production control, and another 28% anticipate its use in the future. However, few service inventory managers report using an MRP system.

- MRP is very effective for complete end items such as manufactured products. The benefit is less evident for service parts, but with the development of enhanced software, MRP should provide an improvement over the traditional fixed-order system.

- A "parent" item in an MRP system spins off other parts as components. A "dependent" inventory item derives its order quantity from the demand of other items. An "independent" item is unrelated to the demands of others and is forecast based on past assumptions through the use of techniques such as ABC analysis, economic order quantity (EOQ) and reorder point (ROP).

  . Procedures, decision rules and input records translate master production schedules into time-phased requirements, with planned coverage of these requirements for each component.

  . The "can order" point considers transportation time from the warehouse to the ordering location as well as the demand reorder point. This allows for the best possible transportation economics.

  . Truck makeup for weight and size may be computed to gain the beneficial economics of truckload quantities.

• The traditional "pull" system, which fills orders only when requested from the field, is often supplemented by a "push" system. This sends stock to the field either when new materials are received from the source or when the stock at any location reaches the reorder point (ROP).

- The "push" system has only recently become practical. Advances in computers and communications have made it technically and economically feasible to communicate data on-line (or at least polled daily) from user locations to a central inventory computer.

- An essential concept of "push" is that the quantity shipped represents a reasonable share of what is available in total, so that the first location to order parts gets a fair allocation rather than everything requested. In other words, the system anticipates multiple demands for parts and derives an equitable allocation scheme.

C. MANUAL AND COMPUTER SYSTEMS

- A manual stockkeeping system with a card for every SKU is effective if there are fewer than 500 SKUs inventoried and transaction levels are under 20 a day.

  - Service representatives must be trained, convinced and controlled in order to assure that a record is made for every part removed from a stockroom or installed on equipment.

  - An uncontrolled stockroom indicates that management feels that controls could cost more than the losses from waste of parts.

- Computerized inventory control offers significant time and cost advantages over manual systems. Many computer systems can pay for themselves in less than a year through inventory cost savings, improved service and management time savings.

  - An interactive inventory control system can be updated instantaneously for every part order, use or other transaction.

- The CRT-based menu for a state-of-the-art service inventory management system includes the range of items presented in Exhibit IV-1.

- Parts orders should be entered interactively. The system should simultaneously check inventory availability and customer credit, and then print picking, packing and shipping documents as well as the customer's invoice. Some companies have stated that the cash flow improvement derived from this level of automation has more than paid for the entire system.

D. REPORTS

- The use of display terminals eliminates masses of computer printout. The CRT permits rapid search for information on a specific part number. The system can be programmed to show usage, dollar value, essentiality and other characteristics, which often saves management time.

  - A part description should be generated each time a number is entered. This provides a human check against possible incorrect numbers and facilitates management understanding and use.

  - Forecasts for future parts usage may be done initially by computer using exponential smoothing techniques, but experienced, knowledgeable people must then adjust the quantities based on expected sales, engineering revisions, production schedules and business economics.

  - A stock-versus-use report is a valuable facility. Parts needed but not stocked are generally apparent due to complaints and high backorder levels. However, dollars are consumed by parts stocked but not used. By showing which parts are not turning over, stock-versus-use analysis pinpoints where inventories should be reduced.

EXHIBIT IV-1

TYPICAL ELEMENTS OF A CRT-BASED INVENTORY CONTROL SYSTEM

- Enter new part
- Display/change part record
- Part availability

- Order/issue parts
- Order parts - routine ROP
- Display/change part order
- Current parts ordered, by part number
- Current parts ordered, by customer/organization/location
- Parts ordered/shipped for service call

- Received parts
- Backorders
- History of orders
- Parts forecast
- Replaceable parts on equipment

- Physical inventory, list
- Physical inventory, variances
- Inventory on hand, by cost
- Inventory on hand, by part number

- Parts used, by cost and profit
- Parts used, by quantity
- Stock versus load
- Basic parts stock

- The use of an automated inventory control system will become more viable to a wider range of vendors as equipment becomes more distributed and inventory costs come under closer scrutiny.

SUBSCRIPTION PROGRAMS: Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed-fee and run on a calendar-year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.

- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,500 companies offering software and processing services in the U.S. and Europe.

- Field Service Program - Provides senior field service managers, in the U.S. and in Europe, with basic information and data to support their planning and operational decisions.

MULTICLIENT STUDIES: Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information and analysis. A multiclient study typically has a budget of over <u>$200,000</u>, yet the cost to an individual client is usually less than <u>$30,000</u>. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry

- The Market for Small Computers in Large Corporations

- Productivity Improvement, 1980-1983, Survival Strategies for EDP Executives

- Opportunities in Communications Services for Digital Information: A Study of User Networks and Needs

CUSTOM STUDIES: Custom studies are sponsored by a single client on a proprietary basis and are used to answer specific questions or to address unique problems. Fees are a function of the extent of the research work. Examples of recent assignments include:

- A determination of the U.S. market for small computer systems in 1985.

- An analysis of the opportunities and problems associated with field service capabilities for CAD/CAM systems.

- An analysis of the market potential for third-party maintenance.

- The 1980 ADAPSO Survey of the Computer Services Industry.

- An evaluation of the current status and future trends of software terms and conditions.

ABOUT INPUT

THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have nearly 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

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